INTERNATIONAL UNION OF RAILWAYS

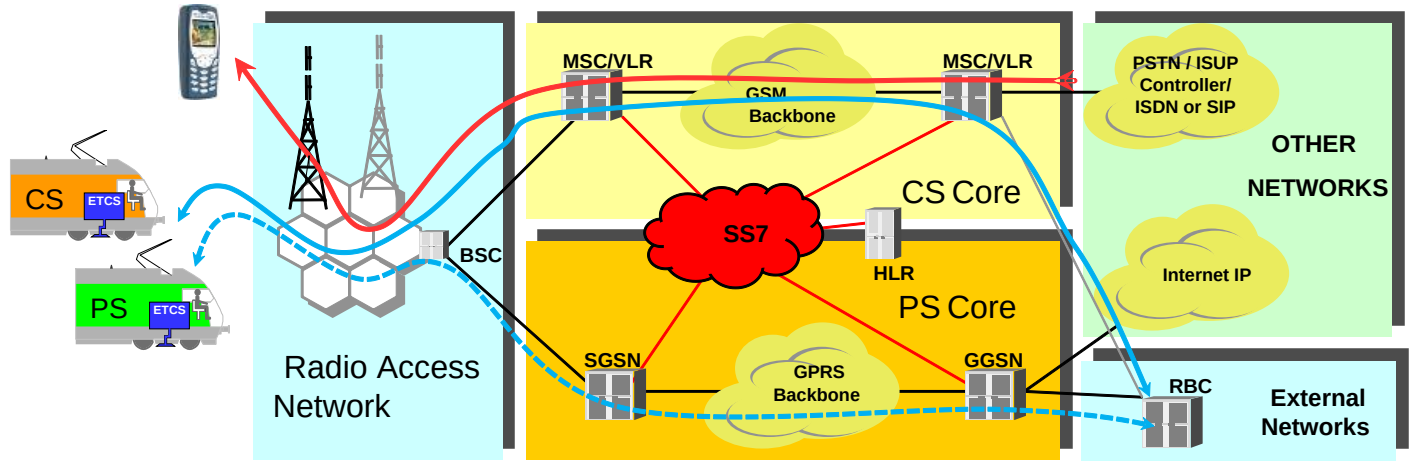
unity, solidarity, universality

GSM-R developments as enablers towards FRMCS

Presented by Ingo Wendler

UIC representative at 3GPP

GSM-R - Today

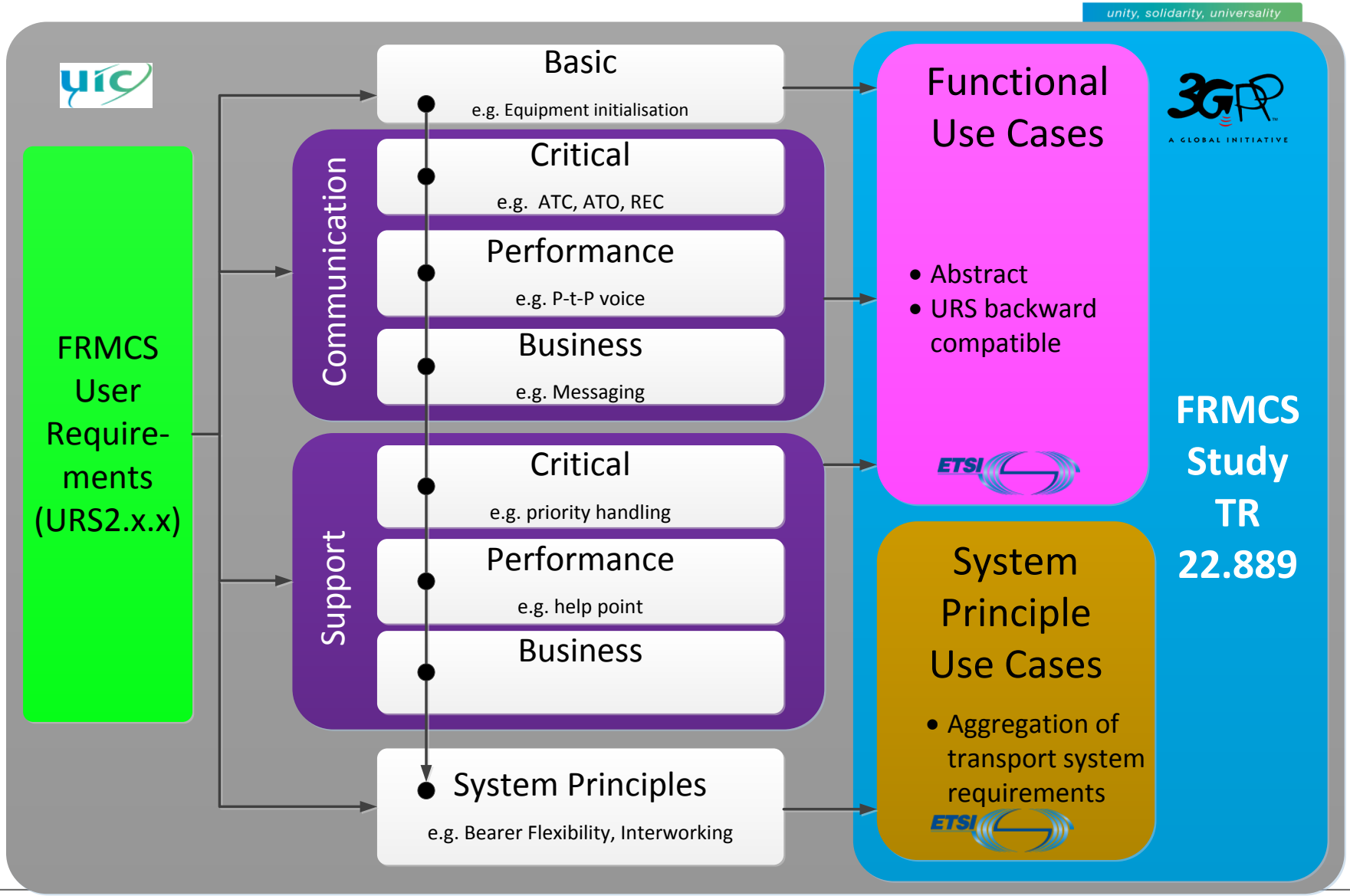


Review

- 3GPP narrowband communication system for voice, data and messaging
- Single Carrier approach paired with a specific frequency reuse
- Spectral efficiency rather low compared to the evolved 3GPP radio access systems
- Limited frequency resources in the UIC and E-UIC frequency band
- Connection oriented communication (Circuit Switched) consumes resources having a low duty cycle
- ETCS can be operated in Packet Switched mode using E(GPRS) bearer
- End-to-End functions are part of the Access and Core network

➢ System limitations may not cover all communication requirements today and in the future!

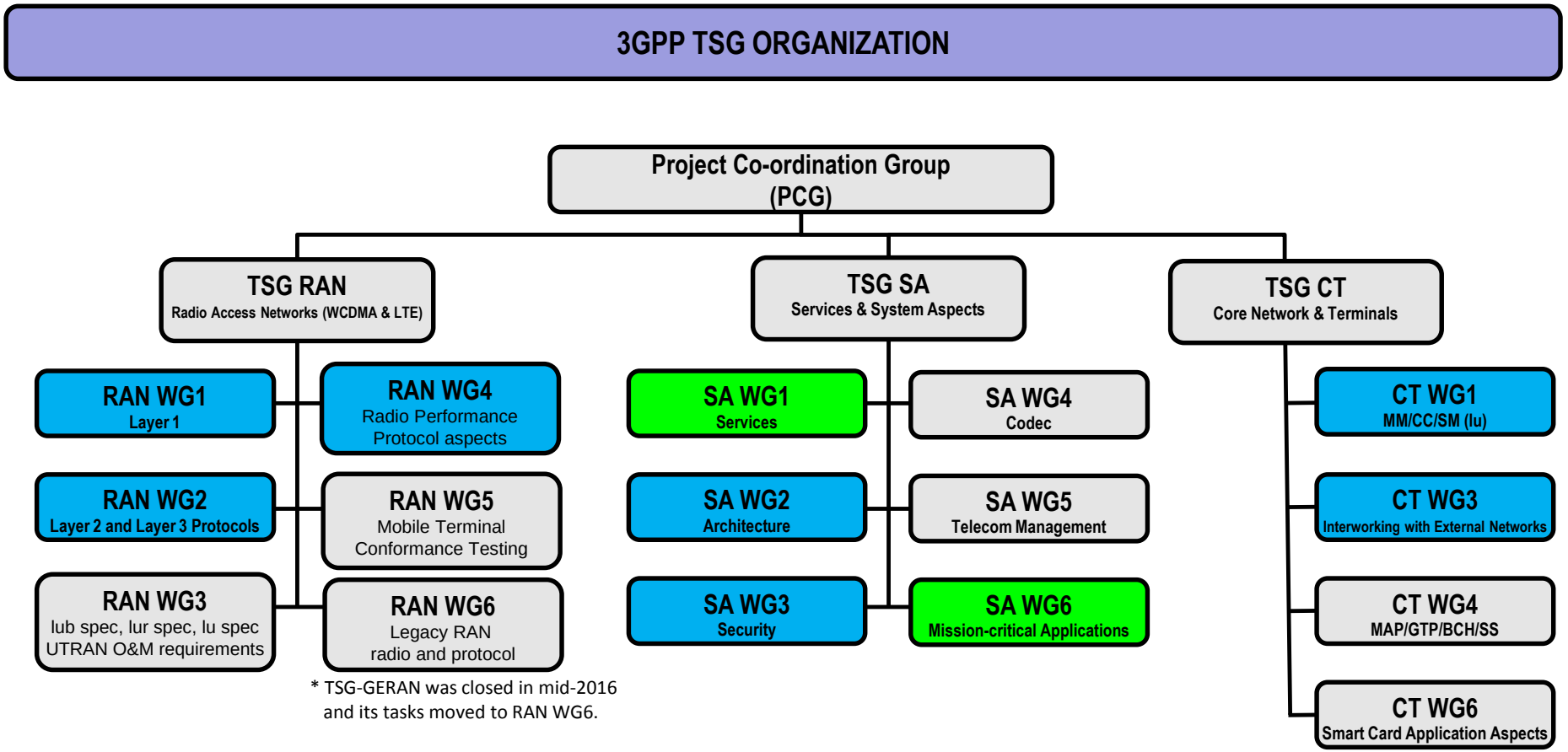
FRMCS Service development



3GPP Organizational Structure

INTERNATIONAL UNION OF RAILWAYS

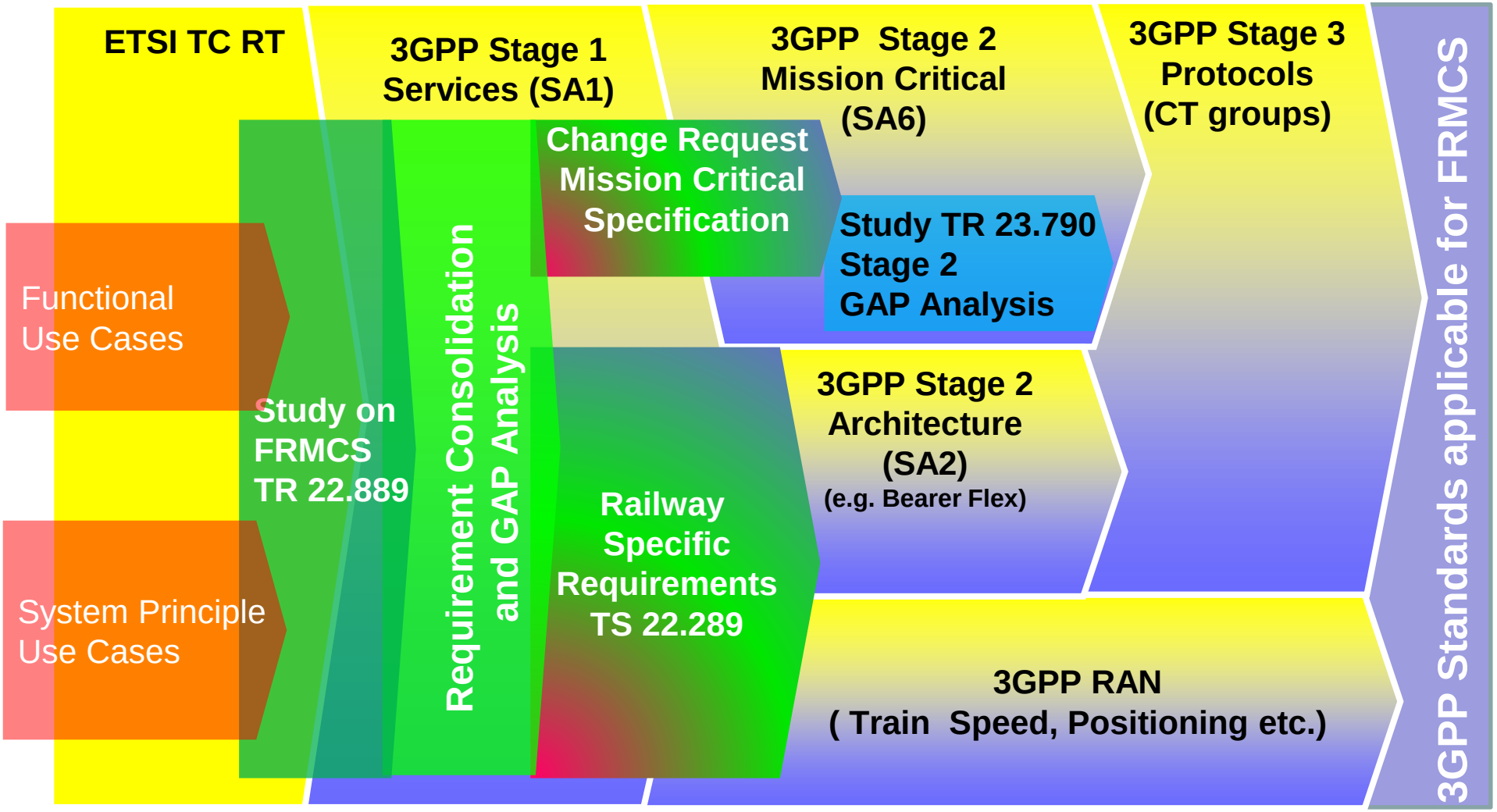
unity, solidarity, universality



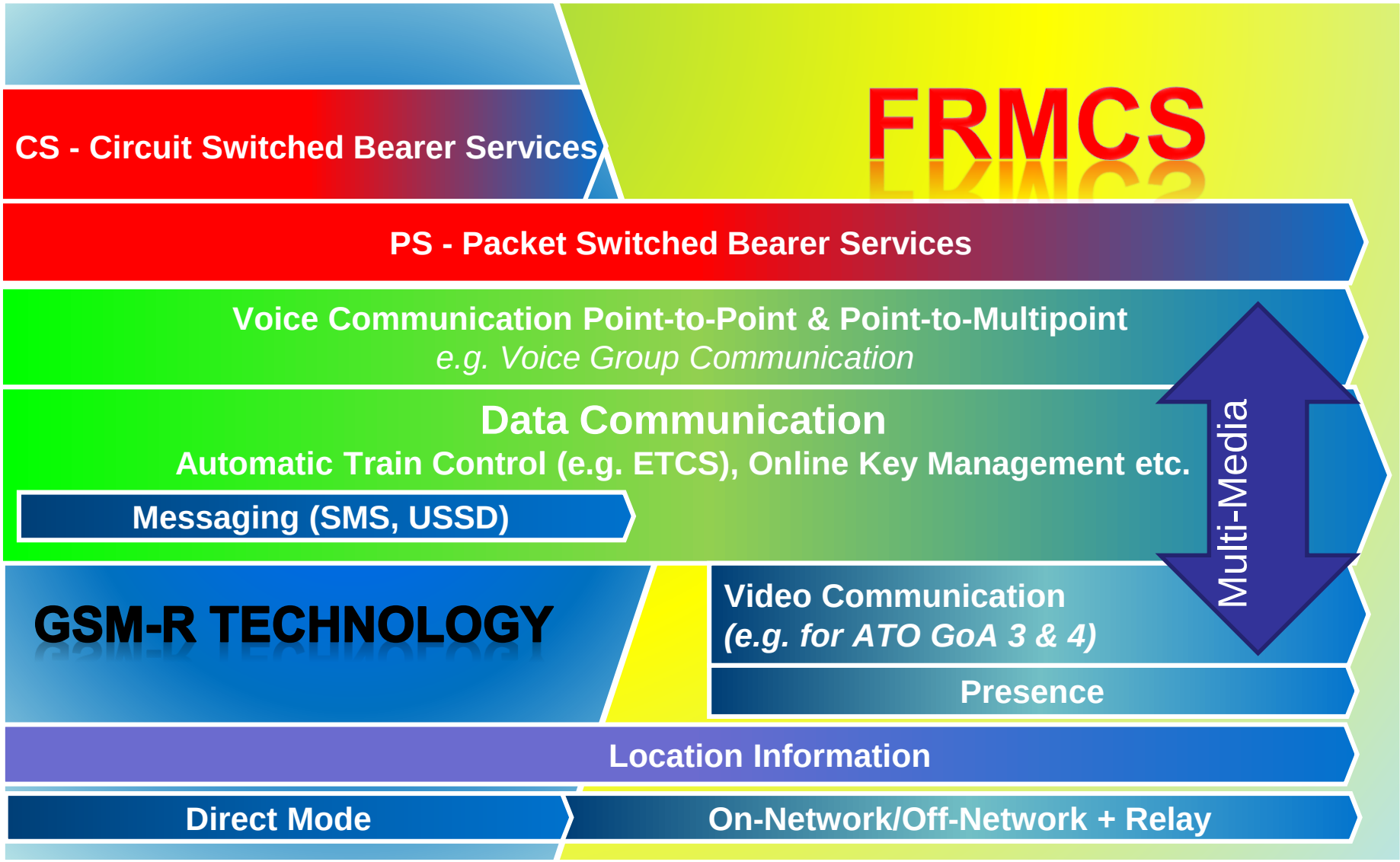
FRMCS at 3GPP

INTERNATIONAL UNION OF RAILWAYS

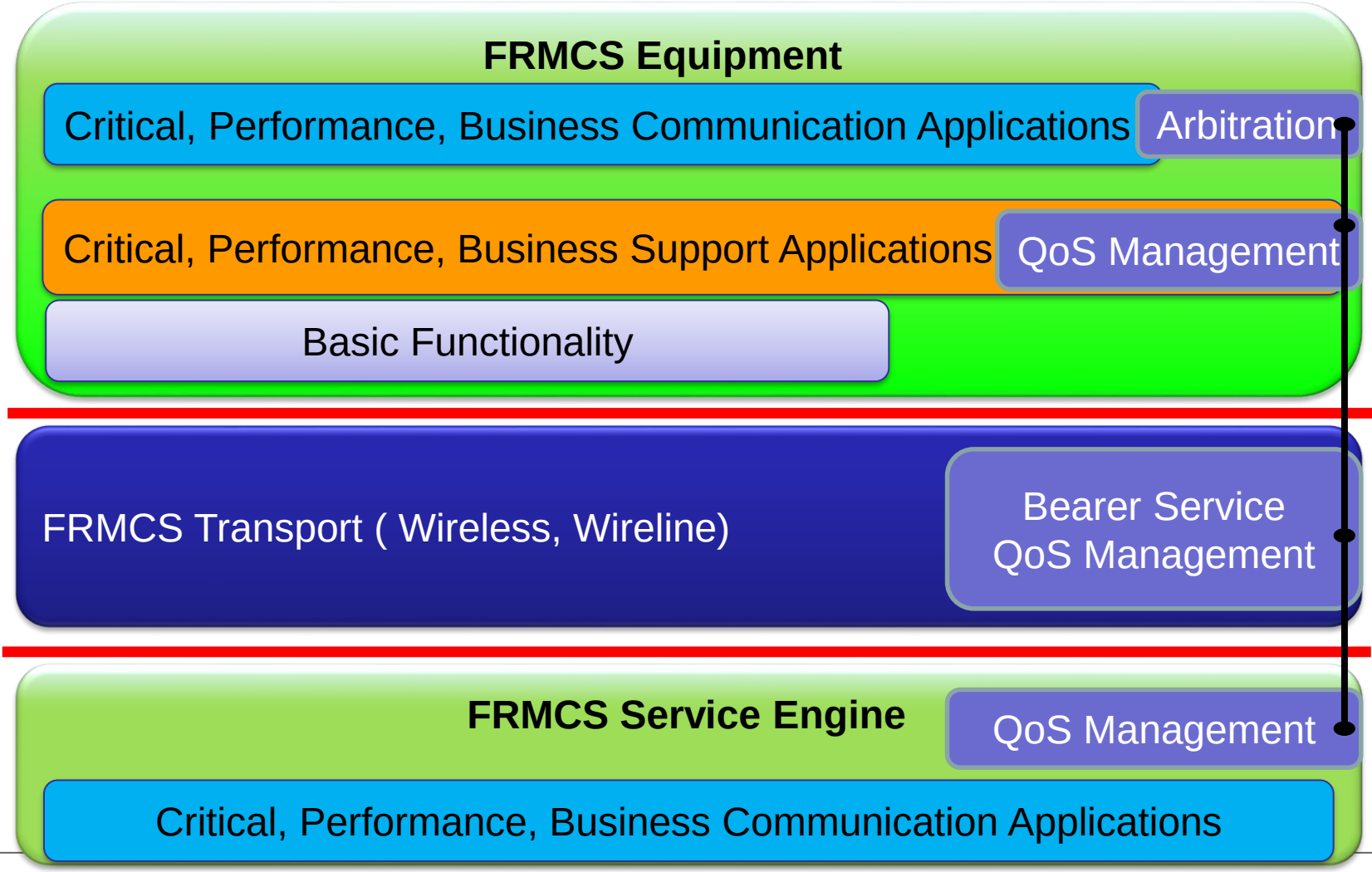
unity, solidarity, universality



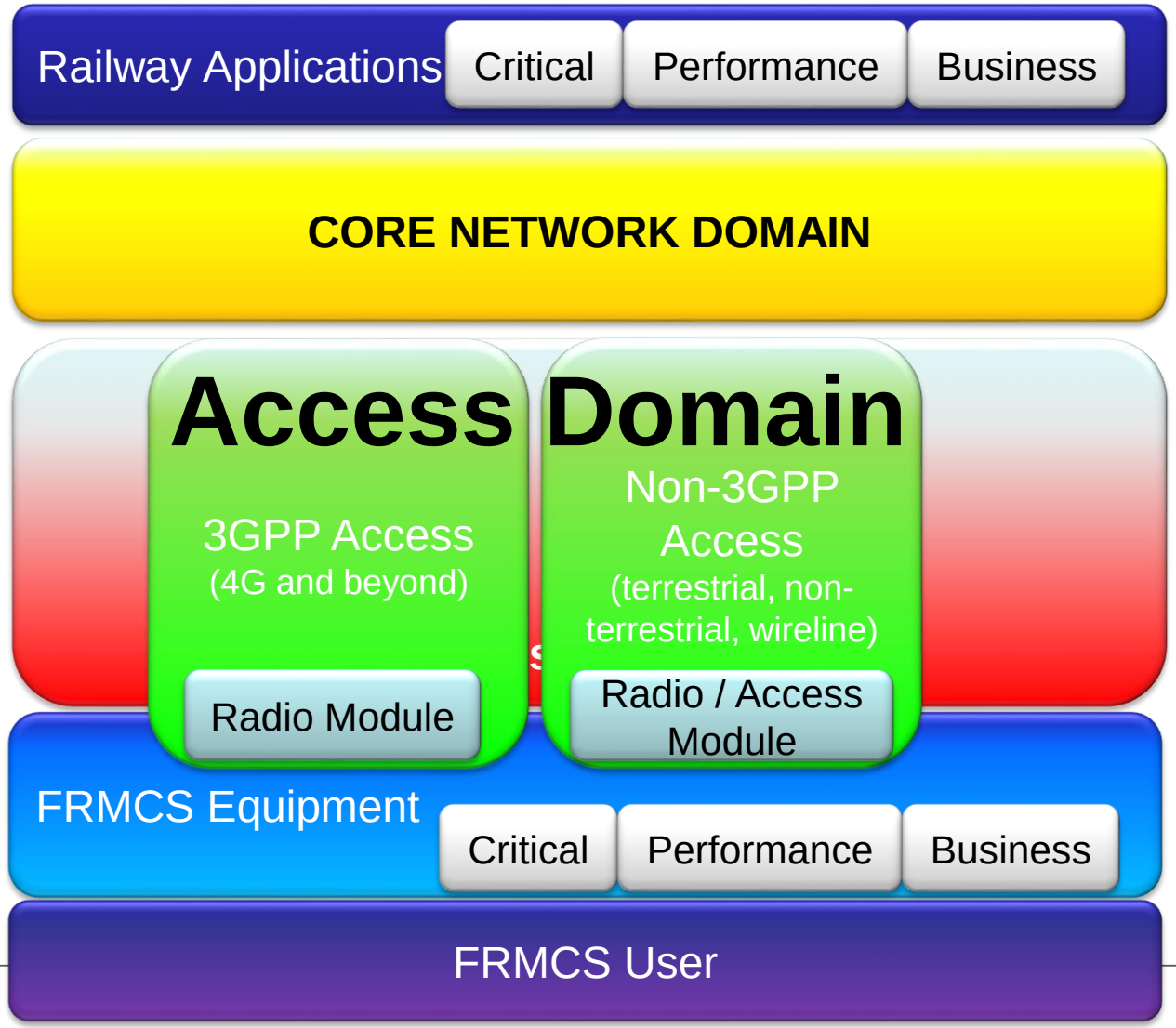
Services


FRMCS
CS - Circuit Switched Bearer Services
PS - Packet Switched Bearer Services
Voice Communication Point-to-Point & Point-to-Multipoint
e.g. Voice Group Communication
Data Communication
Automatic Train Control (e.g. ETCS), Online Key Management etc.
Messaging (SMS, USSD)
Multi-Media
GSM-R TECHNOLOGY
Video Communication
(e.g. for ATO GoA 3 & 4)
Presence
Location Information
Direct Mode
On-Network/Off-Network + Relay

FRMCS Key Principles (1)
Bearer Agnostic approach



FRMCS Key Principles (2) Bearer Flexibility



- **Ability** to follow the 3GPP radio access technology evolution without replacing the entire communication system
- Allows **convergence** on functional level among stationary and non-stationary FRMCS Users
- Requires "**Access Type**" management
- **Bearer Service independent signalling** between the FRMCS Equipment and the Core Network Domain necessary

FRMCS Key Principles (3)

Access Domain

INTERNATIONAL UNION OF RAILWAYS

unity, solidarity, universality

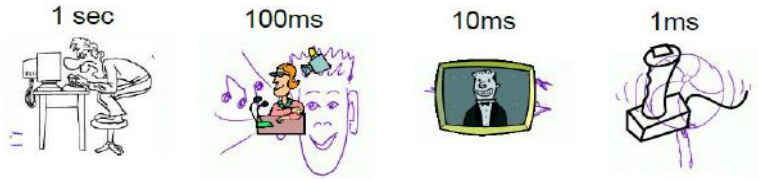
3GPP Access Systems

- Increasing Spectral efficiency - Use of (Super – 3D) MIMO Technology
- Improve robustness against Doppler and Multipath Propagation – High Train Speed capabilities
- Carrier aggregation to increase the transport bandwidth
- Low Latency, very high reliable data communication - essential for automation
- Potential Radio Access Type candidates:
  - LTE / LTE Advanced
  - New Radio (NR 5G) Access will bring further decentralisation of the resources, exploration of the spectrum above 6GHz, Hybrid Multiple Access schemes → balance between random and scheduled access

Non-3GPP Access Systems

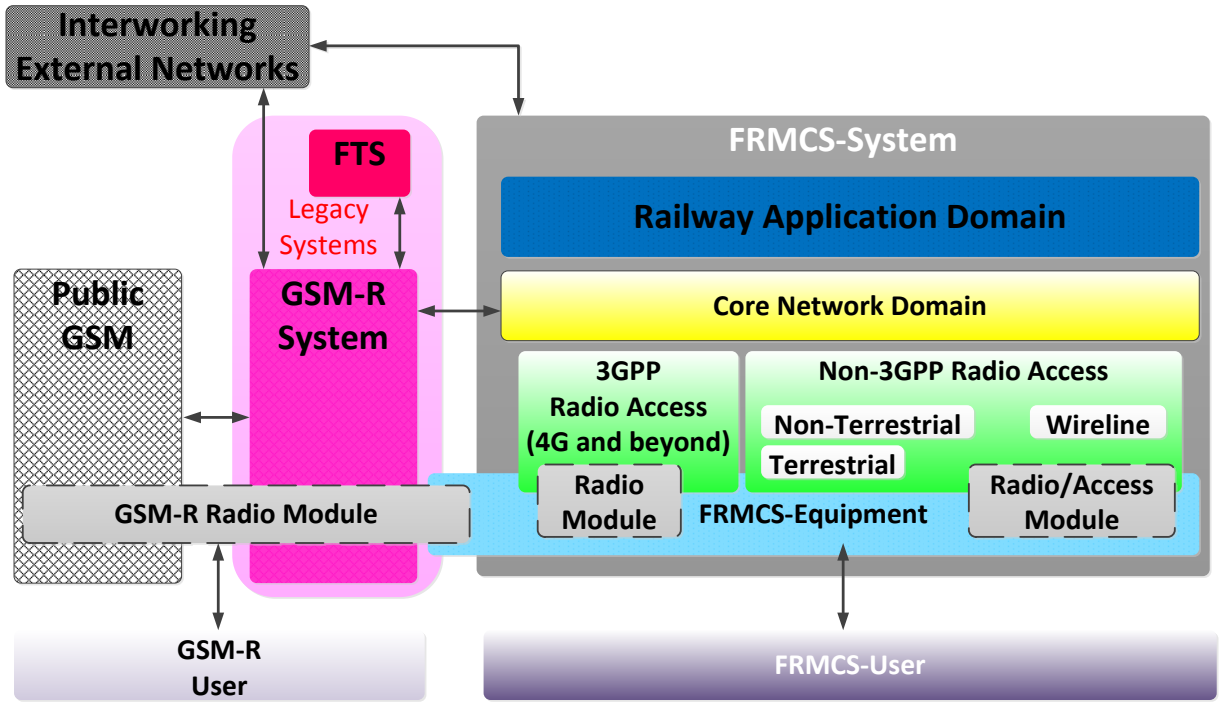
- Complementary to the 3GPP access
- Terrestrial (e.g. WiFi), non-terrestrial (e.g. Satellite) and wireline

"The Tactile Internet": Communications at the speed of human senses



[G. Fettweis, "A 5G Wireless Communications Vision", Microwave Journal, Dec. 2012]

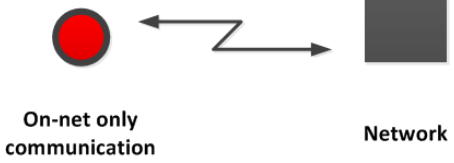
FRMCS Key Principles (4) Interworking

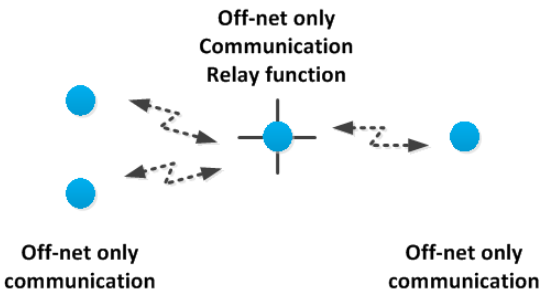


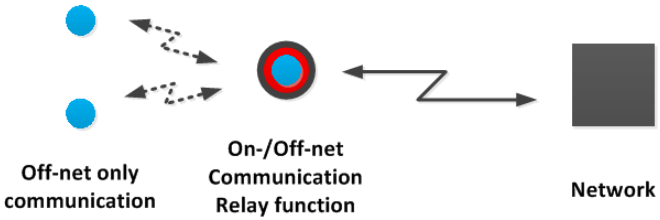
FTS - Fixed Terminal System

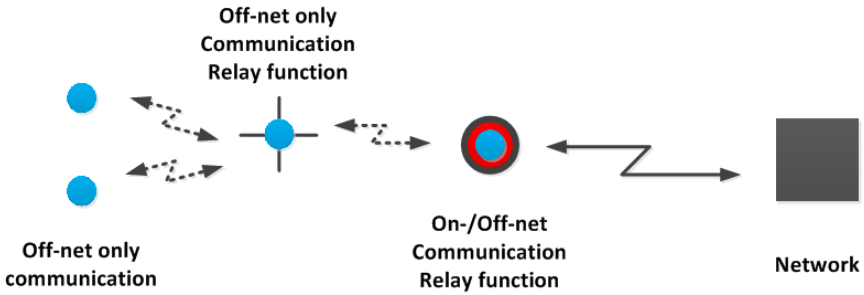
- **Changes to GSM-R** 3GPP specification are not planned
- **Interconnection** for Circuit Switched Bearer Services except data and packet switched bearer services are in focus
- **Functional interworking** comprises Point-to-Point and Point-to- Multipoint communication
- **FRMCS Equipment** should provide GSM-R Radio Module Management facilities
- For **FRMCS User only purposes,** GSM-R can act as transport system!

FRMCS Key Principles (5)
ON- and OFF-network









- FRMCS envisages the support of On-network and Off-network communication mode and the combination of both modes
- Use Cases:
  - Local Communication e.g. shunting(Off-network) including the controller (On-network)
  - ATC Virtual Coupling
  - Backup if On-network communication is unavailable
- Requires and initial On-network mode contact for Authorisation of communication and application

INTERNATIONAL UNION
OF RAILWAYS

unity, solidarity, universality

Thank You!